

WHAT IS CLAIMED IS:

1. A method of detecting leakage of a chemical, said method comprising the steps of:
 - 5 placing a test strip in close proximity of or in direct contact with a suspected leak, said test strip comprising a support material and a color forming composition disposed on said support material, said color forming composition comprising a dye precursor encapsulated in a microcapsule, a developer and, optionally, a filler; and
 - 10 detecting an alteration of the color on said test strip in response to leakage of said chemical.
2. The method of claim 1, wherein said color alteration on said test strip results from having said microcapsule come into contact with
15 said chemical, thereby releasing said encapsulated dye precursor from said microcapsule, thereby allowing said dye precursor to react with said developer, thereby producing said color alteration of said test strip.
3. The method of claim 1, wherein said support material is a
20 substrate in a form selected from the group consisting of: sheet, tape, patch or film.
4. The method of claim 1, wherein said support material is selected from the group consisting of:
25 paper, polymer, paper coated on one or both sides with a polymer, metal, metallized paper, metallized polymer, acetate, polyvinyl acetal, polyester, polystyrene, polypropylene, polyamide, polyimide, nitrocellulose, polycarbonate, polyvinylchloride, a composite, metal/paper laminate, Perlon gauze and a combination thereof.

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5. The method of claim 1, wherein said support material is a paper coated on one or both sides with a polymer selected from the group consisting of: alpha-olefin, polyethylene and combination thereof.

5 6. The method of claim 1, wherein said support material is an acetate film selected from the group consisting of: polyvinyl acetate and cellulose acetate.

7. The method of claim 3, wherein said support material is a
10 composite comprising a polyethylene coated polyester, polypropylene or polystyrene.

8. The method of claim 1, wherein said encapsulated dye precursor is selected from the group consisting of: leuco dye, carbinol
15 based dye, diazonium salt capable of coupling with a coupling agent and a combination thereof.

9. The method of claim 8, wherein said leuco dye is a leuco
base of a triarylmethane dye.

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10. The method of claim 9, wherein said leuco base of a triarylmethane dye is selected from the group consisting of: crystal violet, CI Basic Violet 1, CI Basic Violet 2, CI Basic Blue, CI Victoria Blue, crystal violet lactone, N-benzoyl leuco-methylene blue and a combination thereof.

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11. The method of claim 8, wherein said leuco dye is selected from the group consisting of: phthalide leuco dyes, bisindopthalides, carbazoyl methanes, fluorans and a combination thereof.

12. The method of claim 8, wherein said carbinol based dye is selected from the group consisting of: malachite green, CI Acid Blue 9, CI Food Blue 2 and a combination thereof.

5 13. The method of claim 8, wherein said diazonium salt is the diazotization product of a primary aromatic amine.

14. The method of claim 13, wherein said primary aromatic amine is selected from the group consisting of: 5-amino-1,2,4-thiadiazole,
 10 2-amino-6-nitrobenzothiazole, 2-amino-3,5-dinitrothiophene, 1-amino-2-naphthol-4-sulfonic acid, 2-amino-4-sulfonnic acid, 1-naphthalene-suflamic acid, 4-amino-3-methoxydiphenylamine, 4-amino-2-methoxydiphenylamine, 4'-amino-2-methoxydiphenylamine, 4'-amino-4-methoxydiphenylamine, 4-amino-3-ethoxydiphenylamine, 4-amino-3-hexyloxydiphenylamine, 4-amino-3-beta-hydroxyethoxy-diphenylamine, 4'-amino-2-methoxy-5-methyldiphenyl-amine, 4-amino-3-methoxy-6-methyldiphenylamine, 4'-amino-4-n-butoxydiphenylamine, 4'-amino-3',4-dimethoxydiphenylamine, 4-amino-diphenylamine, 4-amino-3-methyldiphenylamine, 4-amino-3-ethyl-diphenylamine, 4'-amino-3-methyldiphenylamine, 4'-amino-4-methyl-diphenylamine, 4'-amino-3,3'-dimethyldiphenylamine, 3'-chloro-4-amino-diphenylamine, 4-amino-diphenylamine-2-sulfonic acid, 4-aminodiphenyl-amine-2-carboxylic acid, 4-aminodiphenylamine-2'-carboxylic acid and 4'-bromo-4-aminodiphenylamine and a mixture thereof.

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15. The method of claim 13, wherein said diazonium salt has a counter anion selected from the group consisting of: halide, sulfate, hydrogen sulfate, phosphate, hydrogen phosphate, dihydrogen phosphate, hexafluorophosphate, tetrafluoroborate, sulfonate selected from the group
 30 consisting of: methane sulfonate, trifluoromethane sulfonate, toluene

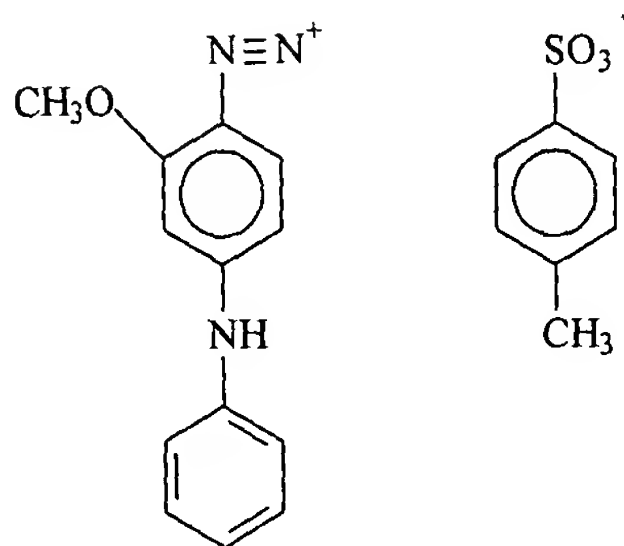
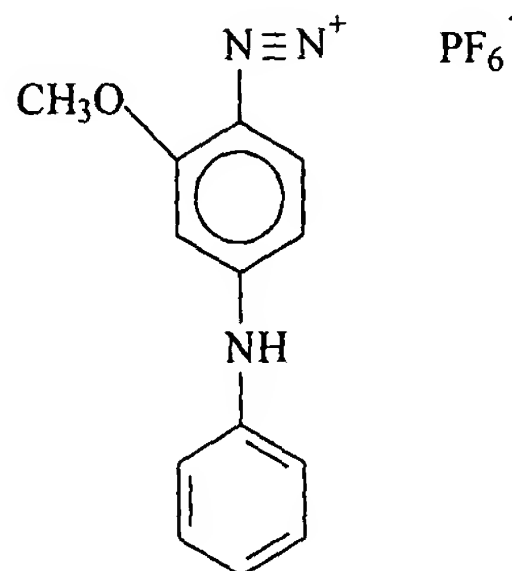
sulfonate, naphthalene sulfonate and mesitylene sulfonate, and any combination thereof.

16. The method of claim 13, wherein said diazonium salt is
- 5 selected from the group consisting of: diphenylamine-4-diazonium sulfate, 2-4-(N-(naphthyl-2-methyl)-N-propylamino)-benzenediazonium sulfate, chloro-diphenyl-4-diazonium sulfate, 4-(3-phenylpropylamino)-benzenediazonium sulfate, 4-(N-ethyl-N-(benzyl)-amino)-benzenediazonium sulfate, 4-(N,N-dimethylamino)-benzenediazonium
- 10 tetrafluoroborate, 4-(N-(3-phenyl-mercapto-propyl)-N-ethyl-amino)-2-chlorobenzenediazonium sulfate, 4-(4-methylphenoxy)-benzenediazonium sulfate, 4-(phenylmercapto)-benzenediazonium sulfate, 4-phenoxy-benzenediazonium sulfate, 4-(benzoylamino)-benzenediazonium hexafluorophosphate, methylcarbazole-3-diazonium sulfate, 3-methyl-
- 15 diphenyleneoxide-2-diazonium sulfate, 3-methyldiphenylamine-4-diazonium sulfate, 2, 3',5-trimethoxydiphenyl-4-diazonium sulfate, 2,4',5-triethoxydiphenyl-4-diazonium sulfate, 4-(3-(3-methoxyphenyl)-propylamino)-benzenediazonium sulfate, 4-(N-ethyl-N-(4-methoxybenzyl)-amino)-benzenediazonium sulfate, 4-(N-(naphthyl-(2)-methyl)-N-n-
- 20 propylamino)methoxybenzenediazonium sulfate, 4-(N-(3-phenoxypropyl)-N-methylamino)-2,5-dimethoxybenzenediazonium tetrafluoroborate, 4-(N-(3-phenylmercaptopropyl)-N-ethylamino)-2-chloro-5-methoxybenzene-diazonium sulfate, 4-(4-(3-methylphenoxy)-phenoxy)-2,5-dimethoxy-benzenediazonium sulfate, 4-(4-methoxy-phenylmercapto)-2,5-
- 25 diethoxybenzenediazonium sulfate, 2,5-diethoxy-4-phenoxybenzene-diazonium sulfate, 4-(3,5-dimethoxybenzoylamino)-2,5-diethoxybenzene-diazonium hexafluorophosphate, methoxycarbazole-3-diazonium sulfate, 3-methoxy-diphenyleneoxide-2-diazonium sulfate, methoxydiphenylamine-4-diazonium sulfate and a combination thereof.

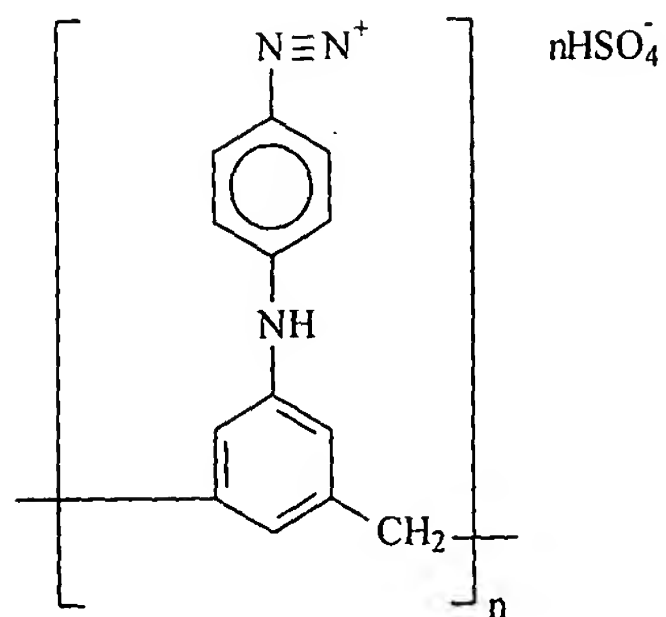
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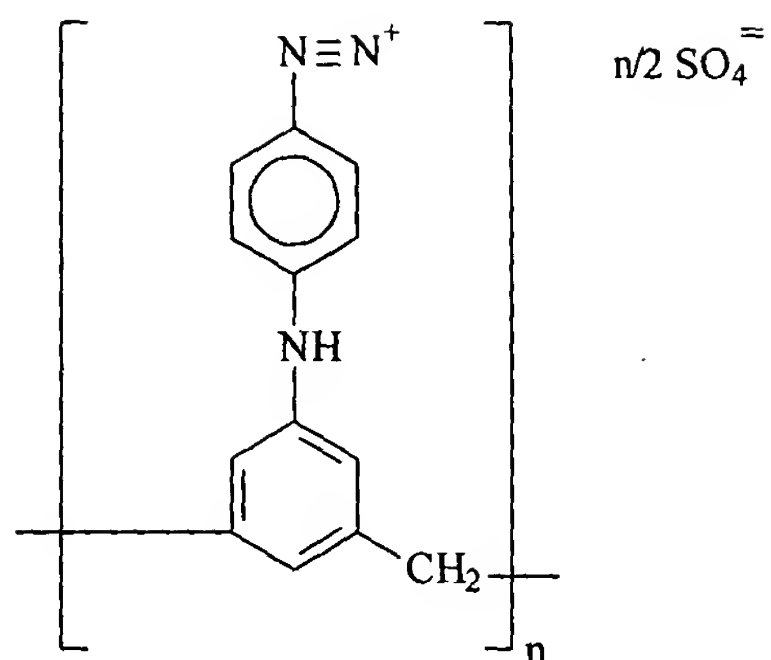
17. The method of claim 13, wherein said diazonium salt is selected from the group consisting of compounds represented by the formula:

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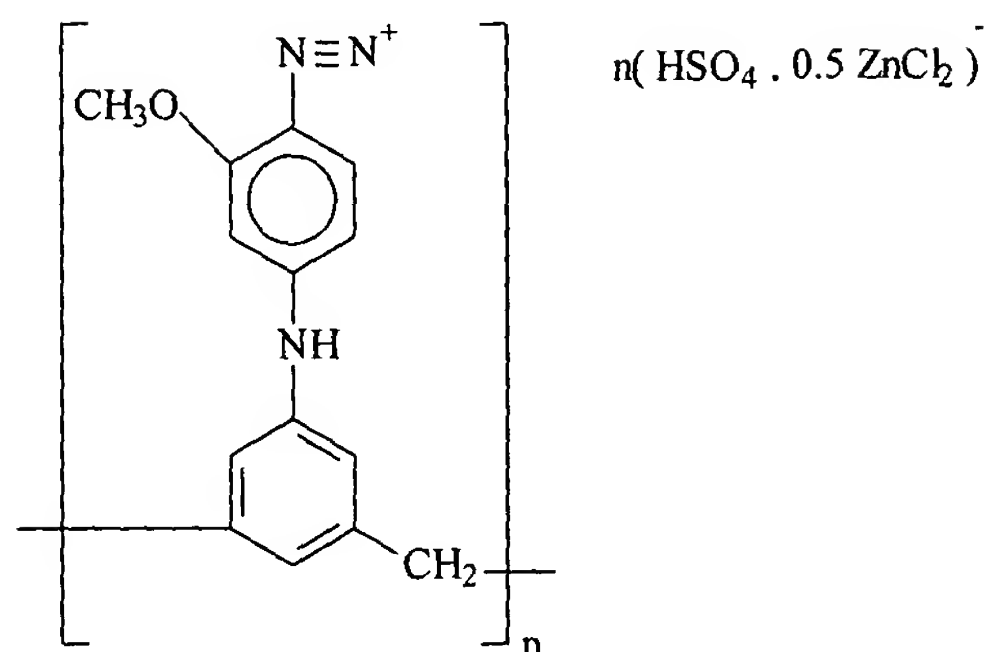
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and

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wherein n is from 1 to 11 and a combination thereof.

- 10 18. The method of claim 8, wherein said coupling agent is
 selected from the group consisting of: 2-hydroxy-3-napthoic acid anilide,
 aromatic amine, phenol, naphthols, pyrrole, pyridene, pyrimidine, indole,
 active methylene compound, acetoacetanilide, 3-methyl-1-phenyl-5-
 pyrazolone, 2,4-dihydroxyquinoline, N,N-dimethylaniline, 3-hydroxy-2-
 15 naphthanilide, naphthylamine, 8-amino-1-naphthol-3,6-disulfonic acid, 7-

amino-1-naphthol-3-sulfonic acid, (benzoyl-acetic acid-2'-[2-(2-hydroxy-3-naphthoylamino) phenylthio]anilide, 1,2-bis (benzylacetamido)benzene, 4-toluenesulfonyloxy)anilide and a combination thereof.

5 19. The method of claim 8, wherein said coupling is carried out in the presence of a basic component selected from the group consisting of: ammonium salts, amine compounds, amides, ureas, thioureas, thiazoles, pyrroles, pyrimidines, piperazines, guanidines, indoles, imidazoles, imidazolines, triazoles, morpholines, piperidines, amidines, 10 formamidines, pyridines and a combination thereof.

 20. The method of claim 19, wherein said a basic component is selected from the group consisting of: ammonium acetate, tribenzylamine, tricyclohexylamine, octadecylbenzylamine, stearylamine, allylurea, 15 thiourea, methylthiourea, allylthiourea, ethylenethiourea, 2-benzyl-imidazole, 4-phenylimidazole, 2-phenyl-4-methylimidazole, 2-undecyl-imidazoline, 2,4,5-trifuryl-2-imidazoline, 1,2-diphenyl-4,4-dimethyl-2-imidazoline, 2-phenyl-2-imidazoline, 1,2,3-triphenylguanidine, 1,2-ditolylguanidine, 1,2-dicyclohexylguanidine, 1,2,3-tricyclohexylguanidine, 20 guanidine trichloroacetate, N,N'-dibenzylpiperazine, 4,4'-dithiomorpholine, morpholinium trichloroacetate, 2-aminobenzothiazole, 2-benzoyl-hydrazinobenzothiazole and a combination thereof.

 21. The method of claim 1, wherein said developer is selected 25 from the group consisting of: an acidic developer for leuco dye precursors and a coupler for diazonium salt precursor.

 22. The method of claim 21, wherein said acidic developer is selected from the group consisting of: propionic acid, butyric acid, valeric 30 acid, caproic acid, caprylic acid, capric acid, lauric acid, myristic acid, palmitic acid, stearic acid, oleic acid, *cis*-9-octadecenoic acid, *cis,cis*-9,12-

"" linoleic acid, *cis,cis,cis*-9,12,15 "" linolenic acid, cyclohexanoic acid, phenylacetic acid, benzoic acid, *o*-toluic acid, *m*-toluic acid, *p*-toluic acid, *o*-chlorobenzoic acid, *m*-chlorobenzoic acid, *p*-chlorobenzoic acid, *o*-bromobenzoic acid, *m*-bromobenzoic acid, *p*-bromobenzoic acid, *o*-nitrobenzoic acid, *m*-nitrobenzoic acid, *p*-nitrobenzoic acid, phthalic acid, isophthalic acid, terephthalic acid, salicylic acid, *p*-hydroxybenzoic acid, *m*-aminobenzoic acid, *p*-aminobenzoic acid and a combination thereof.

23. The method of claim 1, wherein said encapsulated precursor dye is released from encapsulation by at least one of the following: absorption, adsorption, diffusion of said chemical into said microcapsule and said encapsulated dye, dissolution of said microcapsule in said chemical, physical degradation of said microcapsule, dissolution of encapsulated dye in said chemical or rupture of said encapsulation and any combination thereof.

24. The method of claim 1, wherein said microcapsule further comprises a solvent.

25. The method of claim 24, wherein said solvent is selected from the group consisting of: alcohols, ketones, aldehydes, oils, amides, glycols, glycol ethers, esters, phthalates, adipates, branched-acid polyol esters, mixed-acid polyol esters, polyalkylene glycols, alkyl benzenes, benzylated ethylbenzene, phosphoric esters, phthalic esters, carboxylic acid esters, fatty acid amides, alkylated biphenyls, alkylated terphenyls, chlorinated paraffins, alkylated naphthalenes, diarylethanes and a combination thereof.

26. The method of claim 24, wherein said solvent is selected from the group consisting of: benzyl alcohol, glycerol, ethylene glycol, propylene glycol, phenol, *o*-, *m*-, or *p*-cresol, *o*-, *m*- or *p*-chlorophenol, *o*-,

m- or p-nitrophenol, catechol, cinnamyl alcohol, phenyl ethyl alcohol, 1,3-propane diol, pentaerythritol, benzaldehyde, m-nitrobenzaldehyde, o-tolualdehyde, acetophenone, benzophenone, paraffin, silicone, polyvinylether, polyol ester, polyalkylene glycol, mineral oil, alkybenzenes, perfluoropolyether, chlorotrifluoroethylene, hydrofluoropolyether, butanamide, n-methylpropanamide, dipropylene glycol, diethylene glycol, butyl diglycol, butyl triglycol, ethyl diglycol, hexyl diglycol, propyl glycol, diethylene glycol monobutyl ether, ethylene glycol monobutyl ether, ethylene glycol monoethyl ether, diethylene glycol monomethyl ether, tripropylene glycol n-butyl ether, hydroquinone monobutyl ether, diethylene glycol monoethyl ether, triethylene glycol monoethyl ether, diethylene glycol monohexyl ether, ethylene glycol monopropyl ether, ethylene glycol phenyl ether, dibutyl phthalate, diethyl phthalate, diisobutyl phthalate, diisononyl phthalate, diisodecyl phthalate, dioctyl phthalate, dilauryl phthalate, dioctyl adipate, benzyl butyl phthalate, isopropylbiphenyl, diisopropyl naphthalene, n-butyl propionate, tert-butyl hydroquinone, tricresyl phosphate, trioctyl phosphate, octyldiphenyl phosphate, tricyclohexyl phosphate, dibutyl phthalate, dioctyl phthalate, dilauryl phthalate, dicyclohexyl phthalate, butyl oleate, diethylene glycol dibenzoate, dioctyl sebacate, dibutyl sebacate, dioctyl adipate, trioctyl trimellitate, acetyltriethyl citrate, octyl maleate, dibutyl maleate, isopropylbiphenyl, isoamylbiphenyl, chlorinated paraffins, 1,1'-ditolyethane, 2,4-di-t-aminophenol and N,N- dibutyl-2-butoxy-5-t-octylaniline and mixtures thereof.

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27. The method of claim 1, wherein said encapsulated precursor dye is encapsulated by a method selected from the group consisting of:

solvent evaporation, simple coacervation, complex coacervation, polymer-polymer incompatibility, centrifugal force, submerged nozzle process, spray drying, fluidized-bed coating, desolvation, extractive drying, interfacial polymerization, in situ polymerization, biliquid column,

electrostatic encapsulation, ethylene polymerization, very low temperature casting, supercritical fluid extraction and a combination thereof.

28. The method of claim 1, wherein said encapsulated precursor dye has a microcapsule shell material selected from the group consisting of:
- acrylonitrile-butadiene-styrene terpolymer, polyphenylene oxide, polycarbonate, acrylic polymer, styrene, ethylene tetrafluoroethylene, polyvinylidene fluoride, polychlorotetrafluoroethylene, vinylidene chloride,
 - 10 vinylidene chloride/vinyl chloride, cellulosic, polysulfone, polypropylene, polyphenylene sulfide, polyphthalamide, polyamideimide, polyphenylene sulfide, polyester, polyvinylpyrrolidone, polyvinylpyrrolidone/vinyl acetate (PVP/VA) copolymers, PVP/dimethylamino-ethylmethacrylate copolymers, vinyl caprolactam/PVP/dimethylamino-ethylmethacrylate polymers, guar,
 - 15 carageenan, agar, locust bean, gum Arabic, karaya, natural gelatin, methyl cellulose, ethyl cellulose, polyoxymethylene, acrylonitrile-methyl acrylate copolymer, cellulosic material, ethylene-chlorotrifluoroethylene copolymer, ethylene-tetrafluoroethylene copolymer, fluorinated ethylene-propylene copolymer, perfluoroalkoxy resin, polychlorotrifluoroethylene,
 - 20 polytetrafluoroethylene, polyvinyl fluoride, polyvinylidene fluoride, , vinylidene fluoride terpolymer, ionomer, polyparaxylylene, polyethylene naphthalate polyamide, polyetherimide, polyaryletherketone, polyaryletherketone, polyamide-imide, amorphous Nylon, Nylon 6 and PA6, Nylon 66 and PA6,6, Nylon 66/12 and PA6/12, Nylon 66/69, Nylon
 - 25 66/69/61, and PA66/69, PA66/69/61 Nylon 66/610, Nylon, polyamide, polycarbonate, polybutylene terephthalate, polyethylene naphthalate, glycol modified polycyclohexylenedimethylene terephthalate, polycyclohexylenedimethylene ethylene terephthalate, polyethylene terephthalate, liquid crystal polymer, polyimide, polyethylene, polyolefin
 - 30 cyclic olefin copolymer, ethylene-vinyl acetate copolymer, ethylene-vinyl alcohol copolymer, polyethylene-acrylic acid copolymer, polypropylene,

polybutylene, polyphenylene sulfide, polysulfone, polyphthalamide,
polyarylsulfone, polyethersulfone, polyester, polyvinyl alcohol, acrylonitrile-
butadiene-styrene copolymer, acrylonitrile-styrene-acrylate copolymer,
polystyrene, oriented polystyrene, general purpose polystyrene, impact
5 resistant polystyrene, styrene-acrylonitrile copolymer, styrene-butadiene
block copolymer, styrene-acrylate copolymer, styrene-methacrylate
copolymer, polyvinyl chloride, polyvinylidene chloride,
polyethylene/polystyrene alloy, epoxy resin, paraffin wax, polyurea,
polyurethane, urea-formaldehyde resin and a combination thereof.